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ABSTRACT

Word identification latencies and word prediction accuracy were compared for groups of skilled and less skilled fifth grade readers in three experiments. In each experiment, discourse context reduced identification latencies for less skilled as well as skilled readers. This was true both when context was heard and when it was read. The general relationship between word predictability and latency was the same for skilled readers and for less skilled readers, but only less skilled readers' identification latencies were affected by word length and word frequency when the word appeared in context. When subjects predicted the word before identifying it, correctly predicted words were identified more quickly than words not predicted correctly, and skilled readers were more accurate in prediction than were less skilled readers. The results suggest that the use of context in identifying words is not a major source of reading difficulty. (Author/MKM)

READING SKILL AND THE IDENTIFICATION OF WORDS IN DISCOURSE CONTEXT

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Reading skill and the identification of words in discourse context

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Word identification latencies and word prediction accuracy were compared for groups of skilled and less skilled young readers in three experiments. In each experiment, discourse context reduced identification latencies for less skilled as well as skilled readers. This was true both when context was heard and when it was read. The general relationship between word predictability and latency was the same for skilled readers and for less skilled readers, but only less skilled readers' identification latencies were affected by word length and word frequency when the word appeared in context. When subjects predicted the word before identifying it, correctly predicted words were identified more quickly than words not predicted correctly, and skilled readers were more accurate in prediction than were less skilled readers. Although reading-related differences in the use of discourse context may characterize other aspects of reading comprehension, the use of context in identifying words is not a major source of reading difficulty.

The role of discourse context in the identification of words is of central importance not only to models of word identification, but also to models of individual differences in reading. Some recent discussions of the component sources of overall reading ability have emphasized the importance of facile, context-free verbal coding for skilled reading comprehension (e.g., Lesgold & Perfetti, 1978; Liberman & Shankweiler, in press; Perfetti & Lesgold, 1977; Shankweiler & Liberman, 1972). One assumption of this emphasis is that skilled readers, whatever their talents for using discourse context to guide word identification, are individuals with highly developed word recognition and word decoding abilities. Correspondingly, individuals less skilled in overall reading ability are assumed to be handicapped not so much by an inability to use discourse context (although some may have this problem additionally) as by ineffective verbal coding.

However, it is well established that semantic context does affect some aspect of word identification. Tulving and Gold (1963) demonstrated an increase in tachistoscopic word identification accuracy as a function of the amount of prior (nondiscourse) context. More recently, the process by which semantic context influences word recognition has been the subject of considerable theoretical analysis (e.g., Becker & Killion, 1977; Meyer, Schvaneveldt, & Ruddy, 1975; Morton, 1969), a salient issue being what information processing stage is affected by context. An alternative analysis with a more specific application to reading has been described by Rumelhart (1977), following a speech recognition model of Reddy and Newell (1974). This model emphasizes independent processing stages and a decision making system that shares information from all levels of analysis in order to identify words.

Regardless of specific mechanisms by which context affects word identification, a central assumption of the verbal coding model of reading skill (Lesgold & Perfetti, 1978; Perfetti & Lesgold, 1977) is that the contextual processes are limited by word coding processes. By contrast, word coding processes are affected but not limited by contextual processes. In short, verbal coding can be context free, but context use depends on verbal coding. In general, the use of context will not be a problem for many low-ability readers, provided text demands do not exceed their coding abilities.

Contextual constraints, however they work in detail, can be considered examples of textual redundancy. In a text, the effect of any semantic constraint, regardless of its structural and process bases, is to decrease the number of likely lexical alternatives within the text. Thus, in the present experiments word identification is related to textual redundancy indexed by the probabilities of given target words within texts, such as the following one describing the adventures of an elf. "He ran into the kitchen, and in the darkness, he could see the remains of supper. Brownie jumped onto the table and lit a ." This two-sentence segment considerably constrains the possibilities for the deleted word. Intrasentence constraints syntactically select the completion of a noun phrase and semantically select something lightable. Intersentence information adds the constraint that the word must refer to something that

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can improve visibility, rather than something that is merely lightable.

This text example is from a complete story used in Experiment 1 and typifies materials used in all the experiments reported below. The purpose of these experiments was to examine directly the relationship between reading skill and the use of ordinary discourse context in word identification. It is possible that less skilled readers will indeed have difficulty using context when obtaining the context depends on reading. Such an outcome would be predicted by a model emphasizing either context-level or word-level sources of individual differences. Accordingly, the appropriate test for the hypothesis that less skilled young readers can make use of discourse context is one that, as in Experiment 1, allows the reader to hear the context.

EXPERIMENT 1

A straightforward test of the relationship between text redundancy and single-word identification was carried out by use of short stories. Single words scattered throughout the stories were to be vocalized by the subject. The latency to vocalization onset was the dependent measure, providing direct comparisons with previous experiments (Hogaboam & Perfetti, 1978; Perfetti & Hogaboam, 1975). The story was presented aurally except for the visually presented target words. Independently, a measure of text redundancy was obtained by having other subjects predict the occurrence of deleted words in the text. The important questions are whether vocalization latencies of children are reduced by context and whether this reduction is dependent on the child's reading skill. A second question concerns word properties that contribute to identification latency. Latencies of less skilled readers are more affected by word length (Hogaboam & Perfetti, 1978) and word frequency (Perfetti & Hogaboam, 1975) than are those of skilled readers. Discourse context can be expected to reduce the effects of word frequency and word length if the context and word variables affect the same stage of the identification process, but not if independent stages are affected.

A final question concerns memory for the identified words. Words that have occurred in a text should be better remembered than words from a list because of the meaningful structure provided by the text story. Because the processing time of a word (i.e., its latency) in a story can be expected to be less than in a list, any such discourse effect would not be compatible with a processing time account. Moreover, the possibility that less skilled readers process words in a story like words in a list (an implication of the claim that poor readers read "word by word") can be examined. If so, better recognition memory for words from discourse than words from lists might not be expected for less skilled readers.

In connection with the main experiment, two preliminary experiments were carried out. The purpose of the first was to obtain predictability data on the words to be identified in the texts used in the experiment. The purpose of the second experiment was to acquire baseline reaction time to the words that would be used in the texts of the experiments. These two experiments are briefly described in the Method section of the main experiment.

Method

Subjects. A group of 24 children in the fifth grade of an urban school served as subjects in the context identification experiment. The subjects comprised two levels of reading skill, defined by the reading subtest of the Metropolitan Achievement Test, Intermediate Level, administered by research staff. The high-skill group included 12 subjects from Stanines 6-8, with a mean percentile ranking of 77.42 (SD = 10.69); the low-skill group was from Stanines 2-4, with a mean percentile rank of 23.83 (SD = 8.38). Recent IQs were not available, but second-grade IQ scores, available for all but three subjects, indicated a mean of 115 (SD = 6.05) for skilled subjects and a mean of 102 (SD = 8.8) for less skilled subjects. Sex composition of the groups was five boys and seven girls in the skilled group and seven boys and five girls in the less skilled group.

Design and Materials. There were three conditions of word identification: isolated words, list context, and story context. In each condition, there were 20 words presented for identification. In the isolated word condition, each word was presented via a slide projector without context. In the list context, a recorded list of unrelated words was presented through headphones prior to each target word. These words were unrelated to the target word as well as to each other and were included as a modality-switching control, that is, a condition in which the subject would hear words and then switch his attention to a visual display, analogous to the story context but without helpful context. In the story context, a story of 8-½ doubled-spaced pages, "Brownie and Cook," was recorded and presented via headphones. The 20 key words were presented visually at unpredictable intervals varying from 3 to 14 lines of text. There were no target words for the first 30 lines in order to provide ample story context and promote a comprehension strategy on the part of the subject.

Words represented orthogonal combinations of two factors, length and frequency. Words were either short (one syllable, four to six letters) or long (two syllables, five to eight letters). Low-frequency words averaged about 13 (range = 1-32) relative to the 840,857 tokens from the Carroll, Davies, and Richman (1971) count for third-graders, and high-frequency words averaged 167 (range = 90-446). The words were controlled as triples for initial letter and phoneme, length, and frequency. Thus, a word from the context condition beginning with b and having one syllable was matched with two other one-syllable b-initial words of comparable frequency. One of the matched words was in the list condition and the other was in the isolation condition.

Reading skill and task order were between-subjects variables. There were 12 skilled and 12 less skilled subjects, each receiving one of three condition orders. One was (1) isolation, (2) word list, and (3) story context, and the other two were the remaining alternatives of the fixed-order Latin square. Thus, each condition was the first condition for three subjects.

In summary, Experiment 1 represented a mixed factorial design of 2 (reading skill) by 3 (condition orders) by 3 (conditions) by 2 (word length) by 2 (word frequency).

Procedure. Subjects received one of the three conditions in any 1 day. For the isolated condition, subjects saw a series of slides presented one at a time and were instructed to say the words as quickly as they could. Subjects were seated at a table opposite an enclosed viewing screen, at a distance of 40-50 cm. In all identification conditions, onset of vocalization terminated

the slide. In the two conditions involving audio input, the subject listened to an audiotape through isolating headphones. In the list condition, a variable number of unrelated words (3-12) was heard prior to the visually presented word. Since each list was short, the subject was told to keep his gaze on the center of the rear-projection screen for the appearance of the target word. He was told that the words on tape were unrelated to the target word but that listening to them might help him get ready to identify the word.

For the story context, the interval between targets was sufficiently long that a tone was sounded at the start of the sentence that contained the target word. This served as a warning that a target would be occurring soon on the screen, thus making the interval of alertness comparable to the list condition. In both audio conditions, the appearance of the target slide and onset of the timed interval was triggered by an inaudible tone on the second channel of the tape. This signal followed the last context word by about .5 sec. Following completion of all three conditions, subjects were given the recognition memory test of 60 items, 36 targets and 24 foils. The 36 targets included 20 words from the story context condition and 8 each from the story context condition and 8 each from the list and isolation conditions. Subjects responded "yes" or "no" to one item at a time. This test was not given following each session in order not to alert the subject to a memory test, which might have affected identification strategies. Consequently, one-third of the subjects had most recently been in the context condition, one-third had most recently been in the isolation condition, and one-third had most recently been in the list condition. Subjects were tested individually over a period of 3-5 days.

Predictability experiment. The text constructed for the identification experiment was tested for the predictability of the words that were to be identified. The text was tape-recorded and presented to classes of fourth-grade children at a university laboratory school. Compared with children who served in the main experiment, these subjects were somewhat younger (average age = 9 years) and somewhat higher in SES. The task for the subjects was to listen to the taped story and to predict what word would come next when the experimenter stopped the tape player. The experimenter allowed ample time for the children to write their predictions, encouraged guessing when they were reluctant, and then started the tape again. The stopping points were determined by the loci of word deletions of the word identification experiment.

Baseline experiment. In order to have data on identification time for words in the text, a baseline experiment was carried out. A group of 12 fifth-grade students at the school at which the main experiment was done served in the baseline experiment. All subjects were selected to be average in reading skill, and all had scores in fifth-grade decile of the reading comprehension subtest of the Metropolitan Reading Achievement Subtest.

Seventy words, including the 60 used in the main experiment, were presented to the 12 subjects individually, via a slide projector. The procedure was identical to the isolation condition of the main experiment. Following the baseline experiment, there was a recognition memory experiment parallel to the corresponding tests of the main experiment. Thus the baseline experiment provided identification latencies and recognition memory accuracy without context for every word used in the main experiment. This provided between-subjects control to supplement the within-subjects control that was the object of the matched-triples procedure described above.

Results

Identification. Latencies to onset of vocalization were the basic data for word identification. Error rates were low, ranging from less than 1% for story context to 6.5% for isolation, with list condition intermediate (3.4%). Median latencies for correct responses for each subject within a condition were the data for the analyses of variance reported below. Parallel analyses using means produced similar result patterns.

Significant main effects were skill [$F(1,18) = 8.15$, $p = .01$], context [$F(2,36) = 34.34$, $p < .001$], word frequency [$F(1,18) = 12.93$, $p < .01$], and word length [$F(1,18) = 17.65$, $p < .01$]. Two-way interactions were significant for Skill by Context [$F(2,36) = 9.09$, $p \leq .001$], Skill by Word Frequency [$F(1,18) = 5.66$, $p = .01$], Skill by Word Length [$F(1,18) = 7.31$, $p = .01$], and marginally significant for Context by Word Length [$F(2,36) = 3.09$, $p = .06$], and Context by Word Frequency [$F(2,36) = 2.98$, $p = .06$]. There were no significant higher order interactions.

Condition order was not significant as a main effect ($F < 1$). However, condition order did interact with context [$F(4,36) = 3.35$, $p = .02$]. Subjects receiving the order list, isolation, story context did relatively better on the list condition and relatively worse on the isolated and story context conditions.

The means of the medians are shown in Table 1, along with the corresponding means of the baseline group. As can be seen from the last row of Table 1, the different words assigned to the three context conditions produced equal response latencies when they were in the single list seen by the baseline group. This allows a straightforward interpretation of the context data. The salient results are that story context greatly reduced the effects of word frequency and word length, and that story context facilitated word identification for both skilled and less skilled readers.

To test differences where significant interactions were observed, Tukey's HSD tests were carried out. With respect to the Word Frequency by Skill interaction, frequency was a significant factor for less skilled readers but not for skilled readers. Similarly, word length was significant only for less skilled readers.

With respect to context, skilled readers were aided significantly by story context relative to the list condition, but not significantly relative to the isolated condi-

Table 1
Experiment 1: Mean Identification Latencies

Reading Skill	Word Frequency	Word Length	Context Condition I	L	S
Skilled	High	Short	674	741	665
		Long	750	782	667
	Low	Short	711	801	651
		Long	778	819	678
Less Skilled	High	Short	806	857	702
		Long	1037	942	719
	Low	Short	1019	1025	755
		Long	1227	1452	828
			Group Means		
Skilled			728	786	665
Less Skilled			1023	1069	751
Baseline			687	681	681

Note. I = isolation, L = list, and S = story context conditions.

Table 2
Experiment 1 Recognition Data: Proportion of "Old" Responses

	Source of Words			
	S	L	I	FA
Baseline*	.72	.74	.66	.32
Skilled	.79	.69	.40	.23
Less Skilled	.83	.61	.55	.25

*Note—S = story, L = list, and I = isolation context conditions. FA = false alarms. *n = 12.*

tion. While floor effects may be in evidence for skilled readers, the important result is that less skilled readers took advantage of context to an extent at least equal to the skilled readers.

Recognition memory. The results of the recognition memory test that followed the final day of the word identification experiment are shown in Table 2, which indicates the proportion of "old" responses to words of four categories. Two results are noteworthy. First, recognition memory for words seen and vocalized in a story was higher than for words seen and vocalized in isolation. Second, recognition memory was not significantly different for skilled and less skilled readers, except that less skilled readers tended to recognize more of the isolated words than did the skilled readers.

Not shown in Table 2 is a significant interaction of reading skill and word length. Less skilled readers in story context recognized more long words than short words, while skilled readers were not affected by word length. In isolation, both groups tended to recognize correctly more long words.

Discussion

The results of Experiment 1 clearly demonstrate the ability of less skilled as well as skilled readers to take advantage of story context in the identification of words. Indeed the Skill by Context interaction indicated that context had a greater effect on less skilled readers' latencies than on skilled readers' latencies. The results also replicated previous findings of greater effects of word frequency (Perfetti & Hogaboam, 1975) and word length (Hogaboam & Perfetti, 1978) on the latencies of less skilled readers. All these results are more consistent with a model emphasizing word-level sources of overall reading ability than with one emphasizing context-level sources.[1]

EXPERIMENT 2

While discourse context was useful to less skilled readers when it was aural, the possibility remains that when reading is required to obtain the context, less skilled readers will not be so able to make use of it. Thus, Experiment 2 basically was a replication of Experiment 1, with subjects required to read rather than listen to the context, which was provided by a new story.

Method

Subjects. The subjects were those of Experiment 1.

Design and Materials. The story for the reading context experiment, "Snaggle Tooth of Sunken Lake," was about two double-spaced pages in length. It was much shorter than the story for the listening context because of the practical consideration of time and reading demands. The density of target words was accordingly greater, about one every second line.

The word variables were the same as in Experiment 1, word length and word frequency. Short words had one syllable, four to six letters, and long words had two syllables, five to eight letters. Low-frequency words averaged about 14 (range = 3-24), and high-frequency words averaged about 278 (range = 71-810) on the Carroll et al. (1971) third-grade count.

There were two conditions, isolation and story context. Words were controlled across the two conditions as doubles matched on initial letter and phoneme, length, and frequency.

Reading skill and task order were between-subjects factors. Half of the subjects within each skill group had the isolated condition first and half had the context condition first.

Procedures. Subjects received one condition on 1 day and the alternative condition on a later day. The isolated condition was identical to Experiment 1. In the context condition, subjects read aloud the context on 3 x 5 in. cards, each card containing three or four lines of type. Subjects learned to look at the screen immediately after reading the last word on the card. The target word was then immediately exposed in the center of the screen. After identifying the word, the subject turned over the top card and resumed reading aloud from the next card, and so on, until the entire story was read and all 20 words were exposed. As in Experiment 1, the recognition memory test had 60 items, composed of 16 words identified in isolation, 20 words identified in the story context, and 24 foils. It was given on Day 3, following the two identification conditions.

Predictability and baseline experiments. Predictability and baseline experiments were carried out for the materials of Experiment 2 on the same populations and in the same manner as described for Experiment 1. Thus for each word to be identified in the text, there were measures of the word's text predictability and its baseline identification latency, identical to the corresponding measures of Experiment 1.

Results

The analysis of Experiment 2 paralleled that of Experiment 1, except that the context factor represented only two levels of context and, correspondingly, there were two condition orders. Error rates were about 7% for isolation and less than 1% for story context.

Analysis of variance of median latencies for correct responses again showed significant main effects of reading skill [$F(1,20) = 10.16$, $p < .01$], context [$F(1,20) = 8.76$, $p < .01$], word frequency [$F(1,20) = 9.35$, $p < .01$], and word length [$F(1,20) = 7.22$, $p = .01$]. Condition order was not significant [$F(1,20) = 1.79$].

The two-way interaction of Context by Word Length was significant [$F(1,20) = 10.22$, $p < .01$]. However, the three-way interaction of Context by Word Length by Condition Order was also significant [$F(1,20) = 6.36$, $p = .02$]. Subjects in the isolated condition first tended to have relatively long latencies for long words in the isolation condition.

The interaction of Skill by Word Frequency was significant [$F(1,20) = 4.19$, $p = .05$], and other skill interactions, while statistically marginal were similar

Table 3
Experiment 2: Mean Identification Latencies

Reading Skill	Word Frequency	Word Length	Context I	Context S
Skilled	High	Short	630	629
		Long	706	606
	Low	Short	690	649
		Long	701	680
Less Skilled	High	Short	882	749
		Long	941	773
	Low	Short	976	842
		Long	1321	956
			Group Means	
Skilled			682	641
Less Skilled			1030	830
Baseline			790	810

Note—*I* = *isolation and S* = *story context conditions.*

in pattern to Experiment 1. [Skill by Context, $F(1,20) = 3.84$, $p = .06$; Skill by Word Length, $F(1,20) = 3.50$, $p = .08$; Skill by Word Length by Word Frequency, $F(1,20) = 3.73$, $p = .07$.] The latency data are summarized in Table 3.

A significant four-way interaction was found for Skill by Context by Word Length by Frequency [$F(1,20) = 4.56$, $p = .05$]. A Tukey's HSD test indicated significant differences between skilled and less skilled readers were present for all conditions. Word length was a significant factor for less skilled readers except for high-frequency words in story context. Word length and word frequency were not significant factors for skilled readers.

Recognition memory. The results of the recognition memory test are shown in Table 4. Words identified in story context were more likely to be recognized as "old" items more than words in isolation. As in Experiment 1 the advantage of context over isolation did not depend on reading skill. Unlike Experiment 1, there was no reading skill difference in recognition of words in isolation.

Predictability and latency. The predictability experiment provided data that can be used to further examine the effects of context on word identification. The prediction responses of the 70 subjects were classified as target, contextually appropriate, and misses. The most straightforward data are the target probabilities, that is, the percentage of subjects who correctly anticipated the word actually used in the story and vocalized in the word identification experiment. Correlations between target predictability and identification latency were computed separately for skilled and less skilled readers, using the median vocalization latency for a reading group to a given word. The correlations between predictability and latency were $-.62$ for skilled readers and $-.58$ for less skilled readers. The resulting regression lines are shown in Figure 1.[2]

The slopes of the function relating predictability and latency are very similar for skilled and less skilled readers. In support of the analyses of means, it is clear that text redundancy was a powerful factor in word identification, and it was equally powerful for the two levels of reading skill represented in this experiment.

Actually, there are at least two different factors that contribute to a word's identification latency in context. One factor is the predictability of the word in the given context, and the other is the set of variables contributing to the word's baseline identification (e.g., its frequency, length, etc.). Estimates of these two factors were obtainable in both Experiments 1 and 2. The predictability measure was the percentage of target predictions in the predictability experiments. The word's baseline identification factor was estimated by the mean latency of the 12 fifth-grade average readers of the baseline experiments. How well can the context identification latency of a word be predicted given these two factors of predictability and baseline identification?

The 20 words of Experiment 1 were pooled with the 20 words of Experiment 2 for the purpose of examining correlations ($n = 40$) between a word's latency in context and its baseline latency and predictability. These correlations, shown separately for skilled and less skilled readers in Table 5, suggest modest relationships. (The fact that the pooled set of 40 words came from two different experimental tasks should be kept in mind.)

For both skilled and less skilled readers, a word's predictability was correlated with its identification latency in context. However, only for less skilled readers was a word's baseline latency correlated with its latency in context. Thus, while skilled and less skilled readers were equally able to use text redundancy for word identification, only less skilled readers showed evidence that intrinsic word factors continued to influence identification of words in context.

Table 4
Experiment 2 Recognition Data: Proportion of "Old" Responses

	Source of Words S	Source of Words I	FA
Baseline*	.83	.78	.25
Skilled	.73	.53	.24
Less Skilled	.69	.50	.25

Note—*S* = *story and I* = *isolation context conditions. FA* = *false alarms.* *$n = 12$.

Discussion

In general, the word identification results of Experiment 2 were the same as those of Experiment 1. The pattern of main effects was identical, and the skill interactions were in the same direction. Because the two experiments used different texts, straightforward comparisons of the effects of written with aural contexts are not possible. However, it is clear that discourse context facilitated word identification latencies of less skilled

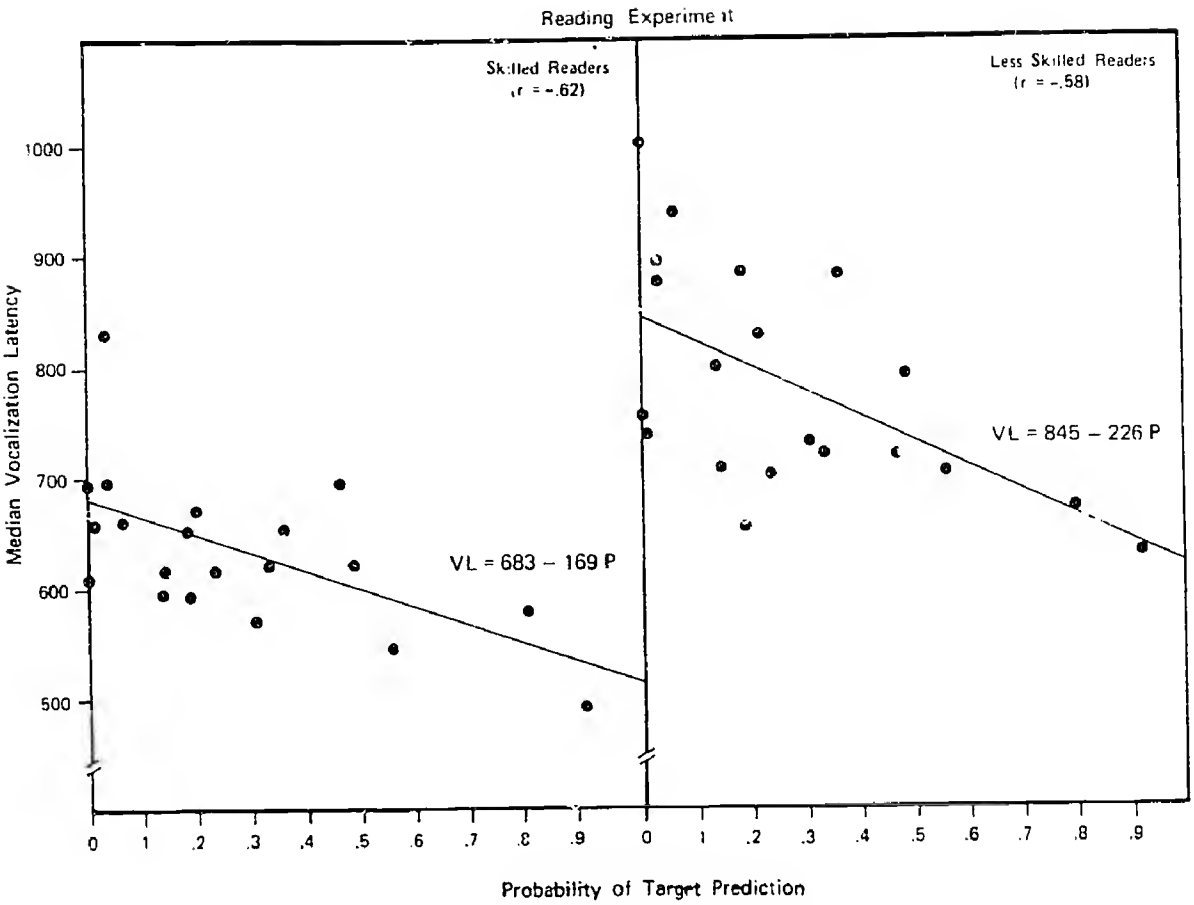

Figure 1. The relationship between identification latency and target predictability for skilled and less skilled readers.

readers, even when reading was required to obtain the context. Moreover, text redundancy eliminated effects in latency due to word frequency and word length. It also increased the memorability of identified words, and it did so regardless of reading skill.

There is no support in data of either experiment for the assumption that less skilled readers are persons who cannot do "top-down" processing. While some less skilled readers might not be good at making use of discourse context in some other sense, every less skilled reader in this experiment identified words faster in context than in isolation. This result is in agreement with results of an experiment by Perfetti, Finger, and Hogaboam (1978), who found that identification latencies of less skilled readers to isolated words were shorter when words were chosen from a reduced set. In that study, differences between skilled and less skilled third-graders were small (but significant) when the words were from a small semantic category and large when the words were from a larger semantic category.

While these experiments have not addressed the specific manner by which the context facilitates word identification, any facilitation mechanism has to include a process by which the reader takes advantage of limits in the range of lexical alternatives permitted within a text segment. At one extreme, this delimiting process can be the anticipation of a particular word. Experiment 3 examines the relationship between a reader's anticipation of a particular word and his latency to identify the word.

Table 5
Predictions of Context Identification Latency by Baseline Identification Latency and Predictability

	Correlation with Word's Identification Latency in Context*		
Group	Baseline Identification Latency	Predictability	Multiple r
Skilled	.05	−.34	.34
Less Skilled	.35	−.42	.50

Note—Correlation between baseline identification latency and predictability (r = −.19, p > .10). **n = 40 words*

EXPERIMENT 3

It seems unlikely that anticipation of specific words is the context mechanism that drives skilled reading. On the other hand, making anticipations explicit causes the preactivation of the word, including the motor program for producing it. Retrieval of the word and preparing its motor program will not be involved at all if a subject has overtly produced the word immediately before seeing it. In this situation, word identification

reduces to word verification. However, suppose a different word is anticipated. Then the verification procedure fails and the correct word must be retrieved. If skilled readers are especially good at context-free verbal coding, as Perfetti et al. (1978) concluded, then they should be little affected by misanticipation. Less skilled readers, on the other hand, should be affected, because it is basic verbal coding that is hypothesized to be the process they have not developed to a high degree of skill.

Further, it is quite reasonable to suppose that general skill in reading and word prediction skill are related. Experiment 3 allowed some assessment of this likelihood, as well as an examination of the relationships between individual identification latencies and anticipation. Subjects read and heard the materials of Experiments 1 and 2, first overtly anticipating each deleted word, and then immediately seeing the word and identifying it.

Method

Subjects. A group of 24 fifth-grade students from the same population as in Experiments 1 and 2 participated in the experiment. No subject had participated in the prior experiments. As before, scores from the reading subtest of the Metropolitan Achievement Test, Intermediate Level, were used to identify two skill levels of reading comprehension. A total of 12 skilled readers were above the 60th percentile (mean = 77.4, SD = 10.7), and 12 less skilled readers were below the 40th percentile (mean = 23.8, SD = 8.4). Mean IQ (second grade, Otis-Lennon) of the skilled group was 114 (SD = 5.9), and mean IQ of the less skilled group was 98 (SD = 9.6).

Design and Materials. The materials and the design were the same as for Experiments 1 and 2, except that there was no list condition for the listening context condition. Thus listening context and reading context could be considered within-subjects factors, each having the same two context conditions, isolation and story context. The context variable was, of course, confounded with story tests, so that the single-experiment design is one of descriptive convenience rather than one to allow comparisons of context conditions.

Procedure. Procedures were the same as for Experiments 1 and 2, except that immediately prior to the exposure of the word to be identified, the subject "guessed" what the word would be. In the listening condition, the tone was a signal to the subject that a guess would be required at the end of the sentence. The subject was instructed that immediately following his guess, the correct word would be exposed on the screen and that he was to say the correct word as soon as possible. The experimenter simultaneously exposed the slide and started the timer by pressing a toggle switch approximately 1 sec after the subject's anticipation. Subjects knew that the exposed word would not necessarily be the word guessed. There was inevitable variability in the interval betwen termination of context and the subject's anticipation. However, all subjects did make an overt anticipation within a few seconds.

The reading context condition was parallel to the listening context experiment. Subjects read cards aloud. The end of a card was the occasion for anticipating the next word and for focusing on the center of the screen, where the word would appear.

Results

Word identification. The first results to report are those parallel to Experiments 1 and 2, that is, latencies to words without respect to whether they were anticipated. (Error rates were approximately 5% overall, with nearly all errors occurring in the isolation condition.) There was a single analysis of variance with listening vs. reading as a context-modality variable. A summary of means of subjects medians is presented in Table 6.

The pattern of results was similar to the first two experiments. Skilled readers had shorter latencies (mean = 717) than less skilled readers (mean = 1,067) [$F(1,22) = 9.88$, $p < .01$]; story context produced shorter latencies than isolated conditions [$F(1,22) = 8.64$, $p < .01$]; high-frequency words had shorter latencies than low-frequency words [$F(1,22) = 12.93$, $p < .01$]; shorter words had shorter latencies than longer words [$F(1,22) = 13.14$, $p < .01$]; and reading context produced shorter latencies than listening context [$F(1,22) = 12.6$, $p = .01$].

Skill interactions were significant for context [$F(1,22) = 5.17$, $p = .03$] and word length [$F(1,22) = 5.54$, $p = .03$]. Both context and word length had greater effects on less skilled readers than on skilled readers. A marginal interaction of Skill by Frequency [$F(1,22) = 3.79$, $p = .06$] indicated a greater effect of frequency on less skilled readers. There was also a significant interaction of word length and word frequency. Length was more a factor for low-frequency words than for high-frequency words.

Adjusted latency analysis. In order to obtain further control over specific word variables, the median of the baseline latency for each condition of Experiments 1 and 2 was subtracted from each subject's latency to each word. The adjustment affected only within-subjects factors. Analysis of variance of these baseline adjusted scores supports the same conclusions as the previous analysis, except that word length and word frequency did not interact. More significantly, it allows the effect of context on word variables to be more clearly seen: Word Frequency by Context, $F(1,22) = 4.43$ ($p = .05$), and Word Length by Context, $F(1,22) = 4.22$ ($p = .05$).

Table 6
Experiment 3: Mean Identification Latencies

Reading Skill	Word Frequency	Word Length	Context: Listening I	Context: Listening S	Context: Reading I	Context: Reading S
Skilled	High	Short	652	695	681	597
		Long	757	730	693	580
	Low	Short	730	783	745	666
		Long	830	781	819	730
Less Skilled	High	Short	969	862	931	688
		Long	1228	910	1005	765
	Low	Short	1488	870	1005	849
		Long	1652	1239	1609	995
			Group Means			
Skilled			742	747	735	643
Less Skilled			1334	970	1138	824

Note. I = isolation and S = story context conditions.

Prediction. To examine prediction data, subjects' guesses were placed into categories of correct, contextually appropriate, and misses. Correct predictions were those that exactly anticipated the word visually presented. Contextually appropriate guesses were predictions satisfying syntactic and semantic constraints of the discourse. Three judges independently classified the subjects' responses. The very few disagreements that resulted were resolved in favor of the majority.

Consistent with the results of the large predictability sample (n = 70) previously described, mean prediction accuracy was higher for the listening context story than for the reading context story. A total of 33% of predictions for the listening context story were correct, 36% were contextually appropriate, and 31% were misses. For the reading context story, the corresponding percentages were 22%, 36%, and 42%, respectively. Since they are consistent with the predictability results of Experiments 1 and 2, these data reflect text differences between the stories rather than modality effects in prediction.

Skilled readers made more correct predictions than less skilled readers [$F(2,44) = 8.08$, $p < .01$]. Across the two context conditions, skilled readers made correct predictions on 32% of the trials, compared with 22% for less skilled readers. The percentages of contextually appropriate responses were nearly equal (37% and 36%). Thus, the advantage of skilled readers in prediction was the ability to more often be exactly correct.

Latency related to prediction. To examine the relationship between word prediction and word identification, identification latencies were compared across the three categories of prediction accuracy. A median latency for each category for each subject provided the basic data. Thus different subjects were represented by different words in the three categories. The results, averaged across listening and reading contexts, are shown in Table 7.

Analysis of variance of these data show significant effects of reading skill [$F(1,22) = 5.55$, $p = .03$] and prediction category [$F(2,44) = 9.55$, $p < .01$]. Although the overall interaction of reading skill and prediction accuracy was not significant [$F(2,44) = 1.17$], the skilled readers were significantly less affected by incorrect prediction than were less skilled readers when the category of misses is excluded.

Thus, on an individual basis, subjects identified words that they had predicted more quickly than words that they had not predicted. A similar conclusion comes from analyzing words separately. Every word was identified more quickly when it was predicted than when it was not predicted. Furthermore, words that were correctly predicted more often had shorter overall latencies. Correlations between the probability of correct prediction and median latency over 12 subjects were .67 for skilled readers and .57 for less skilled readers for reading context. For listening context, the correlations were .46 ($p = .05$) for skilled readers and .34 ($p < .10$) for less skilled readers.

Table 7
Experiment 3: Mean Identification Latencies for Three Predictability Categories

	Prediction Category		
Reader Group	Correct	Contextually Appropriate	Misses
Skilled	656	706	824
Less Skilled	792	972	1000

A relationship between predictability and identification latency is also seen when predictability is measured, as in Experiments 1 and 2, by the responses of the predictability sample. When these percentage measures are correlated with identification latencies of Experiment 3, without respect to whether a subject predicted a word correctly, the figures correspond closely to Experiments 1 and 2: For reading context, the correlation for skilled readers was .73, and for less skilled readers, it was .67 ($p < .01$). The listening context correlations were .40 and −.27, respectively, both nonsignificant but in the expected direction, as in Experiment 1.

GENERAL DISCUSSION

These three experiments lead to the conclusion that word identification of less skilled readers is aided by relevant discourse context at least to the same extent as skilled readers. Indeed, in all experiments, interactions of context with reading skill indicated that context had a greater effect on latencies of less skilled readers. In the four cases in the two experiments in which isolated words could be compared with words in context, the magnitude of the context effect for less skilled readers ranged from 200 to 364 msec, or an average of 280 msec. For skilled readers, whose latencies to isolated words ranged around 700 msec, the context effect never exceeded 100 msec. However, this interaction was enabled in part by the relatively long latencies of less skilled readers to isolated words.[3]

Analogously, the effect of context was also greater for more difficult words. In isolation, the frequency and length of a word both affect its identification latency, especially for less skilled readers (Hogaboam & Perfetti, 1978). In context, the contribution of these variables to latency is greatly reduced, although for adults in tasks not requiring vocalization, context and frequency may be additive (Schuberth & Eimas, 1977). This interaction is what one would expect if discourse context, word length, and word frequency affect the same processes or dependent ones in identifying and producing words. The effect of length and frequency may be on a process of lexical access that has been altered through some preactivation process due to context.

Results of other recent research strengthens the conclusion that lexical processes of less skilled readers

benefit from context. Schvaneveldt, Ackerman, and Semlear (1977), using a lexical decision task, found context facilitation effects for less skilled as well as for more skilled second- and fourth-grade children. Indeed, for the second-grade children, there was a negative correlation between context facilitation and the vocabulary and spelling scores of the Iowa Basic Skills Achievement Test, although the correlation with the reading subtest was not significant. The context effect in a lexical decision task is the gain in decision times when successive words in the task are related (e.g., "nurse" and "doctor") over when they are not related. This is thus an effect that should be especially sensitive to measures of lexical knowledge.

A recent study by West and Stanovich (in press) is more directly supportive of the present conclusion. West and Stanovich found that word identification latencies of fourth- and sixth-grade children were facilitated by brief sentence contexts and that the degree of context facilitation correlated negatively with scores on the Wide Range Achievement Test (WRAT), which is a test of isolated word reading. It is perhaps worth emphasizing that in the present study, reading skill was defined by a paragraph comprehension measure. It is low performance in comprehension that allows the speculation that use of context is a major problem for less able readers. However, the present results offer no support for this speculation, and instead, along with the results of Samuels, Begy, and Chen (1975, 1976), Schvaneveldt et al. (1977), and West and Stanovich (in press) suggest that, at least at the level of word identification, use of context may not be a skill that has been denied to the less skilled reader.

Nevertheless, there is something of a paradox that should serve as a caution against accepting this conclusion without some qualification. The paradox is that less skilled readers benefit from context as much as skilled readers, yet they are not as good as skilled readers at producing contextually constrained words. This is evidenced by the individual prediction results of Experiment 3, in which skilled readers predicted word targets significantly more accurately than less skilled readers. This accuracy advantage included exact target prediction, not just contextually appropriate nontargets. Clearly, skilled readers were more adept at limiting their lexical choices in response to semantic constraints of the sentence.

The resolution of the paradox is to conclude that the development of skilled reading comprehension rests on the development of higher level verbal abilities and the development of rapid, effortless word identification. Indeed, in Experiment 3 the correlation between subjects' identification latencies to isolated words and the number of targets they correctly predicted was .67. Less skilled readers have lower abilities in both word identification and the type of linguistic and nonlinguistic knowledge relevant for success in generating context-appropriate words. However, they have context abilities that are sufficient to provide significant help in identifying words. Skilled readers are already so good at word identification that context is of little consequence. Their word recognition processes are relatively attention free and are executed more quickly than contextual processes sufficient to eliminate lexical alternatives.

If this argument is correct, then there may be conditions in which skilled readers are helped by context more than less skilled readers. Such conditions would be obtained when the process involved is more demanding than the identification of a single word. Where the task is, for example, quickly drawing an inference or encoding an entire phrase or sentence in a brief exposure, the skilled reader's superior knowledge of semantic constraints may be a distinct advantage. There is, in fact, some evidence to this effect from Frederiksen (Note 1), who found that skilled high school readers, more than less skilled, were able to take advantage of context in the recognition of sentences presented at subthreshold exposure durations. However, in the case of word identification, use of context may not be a major source of reading difficulty.

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NOTES

1. Reading ability was not completely independent of IQ in this study, a fact that naturally mirrors the state of affairs in the general population. There are a number of reasons for not forcing IQ matches in such research, one of which is to allow differences other than decoding a chance to be detected. The more important fact for the present study is that the less skilled readers were normal in IQ. It is to this population that we wish to generalize the conclusion that discourse context is readily used by less skilled readers.

2. The correlation between text redundancy and word identification was somewhat less in Experiment 1 ($r = .20$ and $-.35$ for skilled and less skilled readers, respectively). A possible explanation for this lower correlation is that most of the words high in predictability turned out to be low-frequency words. In Experiment 2, by contrast, both frequency and length turned out to be evenly distributed across predictability.

3. The conslusion that less skilled readers were aided more by context than skilled readers must be further tempered by a related statistical consideration. Even though median latencies were used in the analyses of variance to reduce the impact of atypically long latencies, the variances of skilled and less skilled readers were unequal. (This is nearly always the case.) Accordingly, analyses were also done on reciprocal transformations of latencies, which greatly reduce, but do not eliminate, this variance inequality. In these analyses, significant Context by Skill interactions were obtained in Experiment 3, but not in Experiments 1 and 2. This latency-speed discrepancy is not unusual, and the procedure of examining both transformed and untransformed scores is probably advisable (see Wainer, 1977), quite aside from the question of which is the "right" measure. In the present case, it suggests that the interaction depends on the measure used and that the appropriate conclusion is not that less skilled readers are aided more by context but that they are aided at least as much.

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